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PROTEIN - RICH PRODUCTS FOR AID AND TRADE

- Summaries of Reports
  Western Experiment Station
  Collaborators Conference
- Held at Albany, California
  March 15-17, 1967

AGRICULTURAL RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

PROTEIN RICH PRODUCTS FOR AID AND TRADE was the subject of the conference reported here. It was sponsored by the Western Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture, and was held March 15-17, 1967, in Albany, Calif.

This conference is held annually by each of the Department's regional utilization research divisions for representatives (called collaborators) of State Agricultural Experiment Stations in each of the four regions. To assure breadth and depth, a single area of research is chosen as the subject for each meeting. Timely subjects of national and often international importance are selected.

This report consists of summaries of all the speeches presented. In their preparation, effort was made to include all salient facts, without detailed data and citations of sources.

Views expressed are not necessarily those of the U.S. Department of Agriculture. Requests for further information or permission to reproduce or quote must be sent to the speakers. Occasional mention of commercial products or firms does not imply recommendation by the Department of Agriculture.

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CONTENTS

Page

Are Natural Resources Best Used for Food or Fertilizer? Archibald T. McPherson - 3

Resources are Best Used to Improve Agricultural Production, E. L. R. Stokstad - - - - - - - - - - - - - - - - - 5

Problems in Introducing Protein Supplements into Developing Nations, Robert B. Bradfield - - - - - - - - - - 6

Relative Abundance and Distribution of Proteins, Clyde L. Rasmussen - 7

Protein Supplements to Meet Nutritional Needs, George M. Briggs - 8

Fish and Other Aquatic Life as Protein Sources, Harold L. Olcott - 9

Opportunities for Soybeans as a Source of Food Proteins, L. L. McKinney - 9

Making Legumes More Acceptable, Horace K. Burr - - - - - - - - 10

Cottonseed and Peanuts as Sources of Food Protein, H. L. E. Vix - 13

Safflower Meal as a Source of Food Protein, George O. Kohler - 14

Lysine Fortification of Wheat, James W. Pence - - - - - - - - - 15

New Developments in WURLD Wheat, A. I. Morgan, Jr. - - - - - - 15

Cereal Beverages for the Millions, David A. Fellers - - - - - 16

More Food From Wheat, Allan D. Shepherd - - - - - - - - - - - - 17

PROTEIN - RICH PRODUCTS FOR AID AND TRADE

The first two speakers presented opposing points of view. The first advanced arguments in favor of synthetic foods. The second presented the case for natural production with emphasis on increased fertility of soils and other improvements in production. This pro-and-con debate served to dramatize and clarify the issues involved.

ARE NATURAL RESOURCES BEST USED FOR FOOD?

Archibald T. McPherson, Consultant
Washington, D.C.

An emergency program for the synthetic production of food is proposed as a feasible means of meeting the mounting world food shortage. Such a program would be based on the extensive research that has been done on the composition and synthesis of essential nutrients and on the existing commercially successful industries now producing vitamins, amino acids, yeasts, and food colors and flavors.

The principal inputs in synthetic production would be petroleum, fixed nitrogen, and the mineral elements required for plant and animal life. These are the inputs used in modern agriculture. Synthetic processes, however, would be much more economical, because they operate in closed systems and would be free from the extensive losses in agriculture that result from the leaching of fertilizer from the soil by rain and from the toll taken by diseases, insect pests, rodents, and birds. The advantage on the part of agriculture in the utilization of solar energy for photosynthesis would be largely or wholly offset by the extensive use of petroleum on farms as a source of power and heat.

The following advantages of synthetic production would warrant the large initial cost in money, materials, and technical manpower: (1) Large-scale production could be achieved in a relatively short time by the design of standard, automated manufacturing facilities that could be replicated in connection with the industrialization programs of developing countries. (2) A high degree of efficiency could be achieved not only by eliminating the losses that occur in agriculture, but also by producing the synthetic nutrients in the optimum proportions for balanced diets. (3) Since the inputs are widely available, production could be undertaken in nearly any country and would be independent of climate, rainfall or geographic location. (4) Nations could become self-sufficient in food supply, thereby eliminating food and rich crop lands as a source of international conflict.

Estimates of costs, production schedules, and plans for the utilization of synthetic food materials, although not now available, could be prepared within a year by comprehensive interdisciplinary planning operations.

RESOURCES ARE BEST USED TO IMPROVE AGRICULTURAL PRODUCTION

E. L. R. Stokstad, Professor
Department of Nutritional Sciences,
University of California, Berkeley

Various methods for alleviating protein deficiency can be compared on the basis of capital cost and ease and rapidity with which they can be initiated.

The development of high-lysine strains of corn in which the protein has the same nutritive value as casein provides a mechanism for eliminating protein malnutrition where corn is grown. The cheapest and most rapid way of supplementing the proteins of rice, wheat, and present varieties of corn is by lysine supplementation at levels of 0.05, 0.1 and 0.1 percent, respectively. The production of lysine at a cost of 60 cents to $1.00 per pound appears feasible. The yearly cost, as well as the capital cost of supplementing the diet of an adult for a year, would be 16 cents with rice and 32 cents with corn or whole wheat.

Utilization of oilseed-cake meals, which are currently used for animal food or fertilizer in the developing countries, would largely meet the basic protein requirements. The increased production of vegetable oils to the desired level of 50 grams per day would concomitantly provide about 50 grams of oilseed-cake proteins per day. This would represent a two-fold to three-fold increase in oilseed meal proteins and would adequately meet the protein requirements.

The production of protein by fermentation from either carbohydrate or petroleum would cost about 35 cents per pound of protein or $3.50 per year for 12 grams of protein intake per day. This would require a capital investment of $3.70 per capita.

Increased fertilizer production facilities that would produce 33 pounds of plant nutrients per capita would increase agricultural output by 50 percent and would represent a capital cost of $2.80 per person. Since this would increase the output of cereals, legumes, and oilseed meals, this seems the most profitable way of increasing both protein and calorie intake.

PROBLEMS IN INTRODUCING PROTEIN SUPPLEMENTS INTO DEVELOPING NATIONS

Robert B. Bradfield, Nutritionist
Agricultural Extension Service,
University of California, Berkeley, Calif.

Recently a great deal of emphasis has been placed on the development of high-nutritive-value foods from materials not being used presently for human consumption. Press cakes and fish flour are examples of this trend. Very little emphasis has been given to the problems associated with inducing people to consume such products. It would seem obvious that a protein supplement of excellent nutritive quality is worthless if people will not consume it regularly and in reasonable quantities.

It is necessary to learn whether a proposed food will be acceptable at a price at which it can be economically sold in the retail market. In developing countries information regarding many of the factors necessary to make these decisions does not exist. Information is needed regarding nutritional status, traditional food patterns, distribution and promotion costs, and money available for purchasing foods. Sales volume will be determined both by desirability and price and will be difficult to estimate in subsistence economies. To achieve high volume, a new protein food must correspond closely to the ideas held by people regarding requirement of such a food. It must fit into the country's existing patterns of food distribution, procurement, and sales. It should be in such a form that it is suitable for preparation in the customer's home with his normal kitchen utensils. It should not be considered a medicine.

The nature and cost of packaging will be determined by climate, transport methods, time in storage, and nature of facilities at wholesale and retail levels as well as in the home. In these areas, packaging should not only preserve and identify the product; it should also explain the product.

It will be necessary to carry out adaptive research in each country to accurately pinpoint the target groups and methods of reaching them. This research should include (1) all aspects of food procurement, kitchen preparation, methods of home consumption, (2) desirable and undesirable attributes of foods, prestige factors, perceived nutritional value, (3) food beliefs (religious, ceremonial, traditional), particularly regarding health status, pregnancy, lactation, and infancy, (4) advice in feeding, particularly infant, (5) physical form of foods (should a new food be a bulk flour, an enrichment to a traditional food, or a new food?).

RELATIVE ABUNDANCE AND DISTRIBUTION OF PROTEINS

Clyde L. Rasmussen, Industrial Analyst
Product and Process Evaluation Staff, Agricultural
Research Service, USDA, Albany, Calif.

Two-thirds of the world's population live in areas in which per capita food supplies are inadequate in either calories or proteins. The annual per capita income in the diet-adequate areas is ten times that in the diet-deficit areas--$1,000 vs. $100. According to one writer, "The inadequacy of the food supply is due to the extreme poverty in many countries, depressing demand below the nutritional requirements."

Annual availability of food proteins in the world by 1970 will be about 90 million tons of which 27 million tons will be from animal sources. Equal distribution of these proteins would give 67 grams of total protein and 21 grams of animal protein per person per day--probably enough to be considered adequate. With some people actually averaging only 5 grams of animal protein per day, it is obvious that food supplies are badly distributed. These figures do not properly reflect food actually consumed, however, because losses due to various causes may approach one-third of the available supplies in some areas.

By the year 2000, protein supplies in food deficit areas will have to be increased as follows to give the population diets that meet the modest standard of an average of 60 grams of total protein and 10 grams animal protein a day:

	Total protein Tons	Animal protein Tons
Asia	42 million	8 million
Africa	4 million	300 thousand
Latin America	6 million	--

In order to insure adequate supplies to the poorest countries, mainly because rising incomes will funnel off disproportionately larger shares to the higher income groups, increases in protein will have to be even greater than shown.

PROTEIN SUPPLEMENTS TO MEET NUTRITIONAL NEEDS

George M. Briggs, Chairman
Department of Nutritional Science,
University of California, Berkeley, Calif.

To meet the present world shortage of protein foods, agriculturists and food technologists are developing a wide variety of new protein foods and supplements in large quantities. On what basis should they be judged and accepted as nutritionally adequate products? Many procedures that are intended to measure protein quality for man are in vogue or have been proposed, including chemical, chromatographic, or microbial measurement of essential amino acids; rat growth, repletion, and lactation tests; biological assays with protozoa or with other lower or higher animals; amino acid availability tests; and many similar means. The eventual reference standard probably still has to be carefully conducted trials with humans of all ages, because with present knowledge no other test can exactly imitate the complicated conditions of human digestion, absorption, and metabolism. This is especially true when one considers man as he exists under a variety of stresses from growth, reproduction, old age, and various environments. The search still continues for a suitable standard reference laboratory test to adequately measure protein quality for man (probably more consideration should be given to the dog, pig, or monkey).

It is no longer correct to state, without reservation, that animal proteins are better than plant proteins. This is a myth which got its start before modern knowledge of vitamins and minerals, especially vitamin B_{12} and trace minerals. The isolated proteins from animal sources, with the exception chiefly of the protein of egg and possibly of the protein of milk and whole fish, are in general not superior in nutritional value to the isolated proteins of many plant proteins, such as those from soybean, cottonseed, peanut, sesame, pulses, and microbial sources. Especially when fed to animals or man in combinations, many plant proteins have given excellent results equal to any animal protein alone or in combination, as long as all other needs for vitamins, minerals, and energy are provided. Two decades of feeding farm animals in this country with rations containing usually 2 percent or less of animal protein, with excellent results, proves this point.

The requirement for "protein" is actually a requirement for essential amino acids in forms readily available and utilizable and in a rather delicate balance one with another. The best protein supplements for widespread use in human nutrition are those which economically meet the body's need of each essential amino acid in the proper amount and proportion and at the right time. It can be as simple as this, regardless of the source of protein or amino acis.

FISH AND OTHER AQUATIC LIFE AS A SOURCE OF PROTEIN

Harold S. Olcott, Professor
Department of Nutritional Sciences,
University of California, Berkeley

Untapped ocean resources are a promising source of protein which can be used to overcome the known deficit in this nutrient in many of the developing countries. The present world harvest of 50 million metric tons can be expanded to amounts varying from 2 to 20 times as much, depending upon the expert opinion consulted. Examples of unharvested fish resources are hake in the Atlantic and Pacific and anchovy in California waters.

One promising method of utilizing the heretofore unused species of fish depends upon a solvent extraction procedure in which both water and lipids are removed. When whole fish are used as starting material the resultant almost tasteless, odorless powdered product consists of 80 to 85 percent of protein and the rest mostly ash from the bones. The protein has high biological value and is ideally suited to supplement diets low in total protein or consisting mostly of plant proteins. FPC (fish protein concentrate) is made by two procedures: (1) with ethylene dichloride by the VioBin Corporation and (2) with isopropanol by methods recently studied in some detail by the Bureau of Commercial Fisheries.

The U.S. Food and Drug Administration formally approved FPC as a nutritious food fit for human use on February 2, 1967, limiting their approval, however, to the product made from hake. Considerable further study is needed. The problems of which fish to use, the areas where and times of year when they are available, the best solvent, the most economical manufacturing procedure, the manner of incorporation into foods, and the marketing of products are all challenging areas that remain.

OPPORTUNITIES FOR SOYBEANS AS A SOURCE OF FOOD PROTEINS

L. L. McKinney, Assistant Director
Northern Utilization Research and Development Division
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Peoria, Illinois

Soybeans are the No. 1 cash crop in the United States with an annual return of $2.4 billion to farmers. Soybeans are also the No. 1 dollar-earner in the export market, amounting to a billion dollars annually. They are the source of over one-half of the food fat in the U.S. and furnish over 60 percent of the high-protein feed supplements for our great livestock and poultry industries. For 1967, the forecast is for the first billion-bushel crop to be grown on 40 million acres in 26 States. This will constitute over 70 percent of the world crop.

Soybeans offer the most economical source of dietary proteins and fat. They constitute the only commodity produced in sufficient quantity to offer potential for substantially alleviating shortages of protein and fat in the world food supply. A vast amount of basic information on the composition and nutritional properties of soybean protein products is available. Also, a great deal of engineering and processing information has been accumulated. Four basic food products are produced commercially and are consumed as is, or in processed form, in food preparations. These products are defatted soy flour, full-fat soy flour, "protein 70," and isolated soybean protein.

In cooperation with AID and UNICEF, the Northern Utilization Research and Development Division has developed two practicable processes for making full-fat soy flour in developing countries. One is a simple process that can be installed and operated in a village at low cost to produce a few hundred pounds of flour per day; the second is a more sophisticated process capable of producing several tons of flour per day for large urban areas. Full-fat flour was chosen because it offered the most economical source of both protein and calories for incorporation into native food preparations.

MAKING LEGUMES MORE ACCEPTABLE

Horace K. Burr, Chief, Vegetable Laboratory
Western Utilization Research and Development Division,
Agricultural Research Service, USDA,
Albany, Calif.

Beans, peas, and lentils are delicious, nutritious, and economical, but they have two important shortcomings: (1) they are slow to rehydrate and to cook and (2) eating them causes flatulence in most people. Research on these two characteristics of legumes has been conducted in our Division.

The purpose of one study was to measure the cookability of beans as it is influenced by variety, moisture content, temperature, and time of storage. Pinto, Sanilac, and large lima beans were used. These were adjusted to moisture contents in the range from 8 to over 16 percent. Samples of the 1961 crop were stored at 70° and 90°F.; those of the 1963 crop were stored at 40°, 55°, and 70°F. Periodically samples of the stored beans were presoaked and their cooking rates measured objectively by means of an experimental cooker.

Beans stored at a moisture content below about 12 percent retained reasonably good cookability for 2 years under the conditions studied. However, at higher moisture contents the required cooking times increased more or less rapidly during storage. The higher the temperature, the more rapid the loss of cookability. Although the limas initially cooked more rapidly than the pintos or Sanilacs, the responses of all three legumes to moisture content and time and temperature of storage were very similar. Data for materials from the 1961 and 1963 crops at 70°F. were in good agreement.

An important conclusion from this study is that a serious loss of cookability may occur in beans under conditions that may be encountered frequently in distribution. For example, there was a 2-1/2- to 5-fold increase in cooking time in beans stored 1 year at 70°F. and moisture contents of 15.5 to 16.7 percent. It must be remembered that under the U.S. Standards for Grades, beans do not have to be marked as "high moisture" unless they contain more than 18-percent moisture. It is suggested that the industry consider three possible steps to protect the cooking quality of their product: (1) Artificial drying of high moisture beans, (2) use of more moisture-proof packaging, and (3) cooler storage of beans.

Legume products that are relatively quick to prepare for serving, have been developed by WURDD on a laboratory scale. Among these are precooked legume powders. They are made by soaking beans, peas, or lentils, cooking them, and drying them on a single- or double-drum dryer. They can be used for making such foods as soups, cocktail dips, souffles, and refried beans. Precooked legume powder might be marketed as a staple, like wheat flour, to be used in a variety of recipes. It might also be mixed with other dry ingredients, packaged, and sold as instant dry mixes for soups and other dishes.

At our Pasadena laboratory, Louis Rockland has developed quick-cooking whole bean products. He infiltrates beans with an aqueous mixture of sodium chloride, sodium tripolyphosphate, sodium bicarbonate, and sodium carbonate. Following treatment, the beans are either dehydrated to give a dry product, or frozen. In either case, the product cooks tender much more quickly than untreated beans.

The other problem which is common to legumes is their tendency to cause flatulence when eaten. Flatulence is simply the accumulation of gas in the intestinal tract and it unquestionably limits the acceptability of legumes to many people. Intestinal gas is a mixture of carbon dioxide, hydrogen, nitrogen, oxygen, and, in some people, methane. Our research on flatulence has been carried on through contracts with Standard Research Institute and the University of Illinois, and in-house. Our present work is being conducted in close cooperation with the Department of Nutritional Sciences at the University of California, Berkeley, and the principal investigators are E. L. Murphy of WURDD and Doris Calloway of University of California.

Several possible sources of intestinal gas have been suggested: Microbial metabolism of food constituents, the reaction of gastric acid with bicarbonate of the pancreatic and other secretions, the swallowing of air (aerophagia), or the diffusion of dissolved gases from the blood into the intestinal lumen.

From about 4 to 6 hours after one eats a bean meal, there is usually a several-fold increase in the volume of gas released from the rectum. Usually there is also a smaller, secondary peak of flatus release about 9 or 10 hours after the meal is eaten. If one measures the hydrogen content of the expired breath, a very similar pattern is found. Large differences exist between individuals in the amount of gas passed rectally. All those studied showed a substantial increase in breath hydrogen a few hours after eating beans but again there were large differences between subjects.

A number of hypotheses have been advanced to explain why eating beans causes flatulence. Several of these have already been disproved, but one has very recently been established as at least a partial cause. Legumes in general contain two somewhat unusual sugars, stachyose and raffinose. Man's digestive system is not known to produce an enzyme which will split these oligosaccharides, but some intestinal microorganisms appear to. Drs. Calloway and Murphy fed stachyose and raffinose to human subjects and observed the characteristic rise in breath hydrogen indicative of flatulence. It appears that these compounds are not split into simple sugars and absorbed in the upper gastrointestinal tract as sucrose, for example, would be. Instead they move down the intestine where they are attacked by the microflora and metabolized to yield hydrogen. Surprisingly, it was found that subjects fed stachyose and raffinose showed no increase in the volume of gas released rectally. It is concluded that while these oligosaccharides can account for the hydrogen component of the gas associated with beans, they probably cannot account for all the carbon dioxide.

An important part of this research program is a systematic isolation of the flatulence factors. Cooked beans are fractionated by a variety of physical and chemical methods and each fraction or subfraction is tested for flatulence activity in human subjects. In this way, practically all of the original activity has been concentrated in one fraction representing only about 10 percent of the dry weight of beans. It contains stachyose and raffinose, along with many other constituents, some of which may also have flatulence activity.

The information being obtained in this project should make it possible to solve the practical problem of eliminating flatulence from beans and other legumes. Once the chemical identity of the factors is known, it may be possible to remove them selectively during the processing of beans. Another approach would be to breed new varieties of beans essentially free of the undesired compounds. Finally, if the mechanism by which beans cause flatulence is understood, it may be possible to add to beans another biologically active compound which will neutralize the flatulence effects.

COTTONSEED AND PEANUTS AS SOURCES OF FOOD PROTEINS

Henry L. E. Vix, Chief, Engineering and Development Laboratory,
Southern Utilization Research and Development Division,
Agricultural Research Service, USDA, New Orleans, La.

Cottonseed and peanuts are two of the principal oilseeds in the world and good potential sources of high-quality food proteins. The annual world production is about 25 million tons of cottonseed and 18 million tons of peanuts. They are exceeded only by soybeans which reached an annual world production of approximately 35 million tons.

The annual production of cottonseed and peanuts is equivalent to about 8 million tons of protein. This protein is available for supplementation of human diets for millions and millions of people.

Current processes practiced by industry in this country and in many foreign countries yield protein-meal products from both cottonseed and peanuts, which are generally used as feeds for farm animals and poultry. Little of the production actually finds uses as human food.

With immediate urgent need for food proteins, particularly in developing countries, attention is being focused throughout the world on these two indigenous oilseeds as sources of high-grade proteins in the form of edible flours.

Investigations under way in the Southern Utilization Research and Development Division (SURDD) and other institutions in this country and throughout the world are yielding advanced developments in technology and engineering. These developments are making possible the production of food-grade flours from both cottonseed and peanuts with protein quality essentially equivalent to that in the original oilseeds.

In the development of food-grade flours from cottonseed and peanuts several processing problems require attention and solution to insure wide acceptance. These are maintenance of high nutritional value, removal of undesirable contaminants, sanitation, color, taste and flavor.

For cottonseed, in addition to the above problems, there must be adequate removal of gossypol. At SURDD, research has led to development of several extraction processes. These adequately remove gossypol and yield a final flour product that meets most quality requirements for use in food formulations.

Processes at SURDD have been developed for producing partially defatted peanuts, partially defatted peanut meal and flour, and fully defatted peanut flour. These products show potential for use in many food applications, not only in this country but throughout the world. These developments will result in higher-quality protein flours from cottonseed and peanuts than those currently produced from these oilseeds and should eventually greatly increase their utilization in foods throughout the world.

SAFFLOWER MEAL AS A SOURCE OF FOOD PROTEIN

George O. Kohler, Chief, Field Crops Laboratory,
Western Utilization Research and Development Division,
Agricultural Research Service, USDA, Albany, Calif.

Safflower has been grown for centuries in the Nile Valley and in parts of Asia. It is a newly established U.S. crop and is expected to be a major one. It is well adapted to dry climates. Where adequate soil moisture is available safflower, rich in high-quality oil and protein, yields over a ton of seed per acre. Chick feeding experiments indicate that the meal is relatively free of physiologically deleterious components and, properly supplemented, produces high growth rates. The relatively high content of sulfur amino acids and low content of lysine suggest combinations with soybean protein.

A survey of over 3,000 varieties of safflower is now under way in an effort to discover high-lysine characteristics that might be used in developing new varieties with even higher quality protein.

Laboratory processes have been found for production of food-grade protein concentrates which are very low in fiber and free of objectionable flavors. The production of textured proteins and protein isolates is also feasible. The potential of safflower as a source of human food protein is high, but more research is needed before this potential can be commercially developed.

LYSINE FORTIFICATION OF WHEAT

James W. Pence, Chief, Cereals Laboratory
Western Utilization Research and Development Division,
Agricultural Research Service, USDA, Albany, Calif.

Almost all wheat consumed in many Asiatic and African countries is converted to an essentially whole-meal flour used mainly for simple, quickly baked breads. For example, wheat in India is used chiefly for chapattis, a home-baked pancakelike product. As much as three-fourths of U.S. wheat received is directed by the Indian government to retail shops which sell a few pounds at a time for grinding in small village mills. Fortification of this wheat with synthetic lysine offers a simple inexpensive way to increase the quality of dietary protein on a massive scale. Principal benefit would accrue to pre-school children. Concurrent measurement of such benefit might be obtained from controlled feeding tests involving up to 1,000 children in orphanages or schools and up to 100,000 persons in selected villages.

Fortification of grain can best be accomplished by blending heavily fortified wheat with normal wheat at time of ship loading. Lightly scarified wheat soaked in hot strong lysine solutions will absorb 10 to 12 percent of the amino acid without loss of structural stability or significant change in appearance. Addition of 0.1-percent lysine to whole wheat will raise its protein efficiency ratio (PER) from 1.1 to 1.3 up to about 1.7 to 1.9. On a sufficiently large scale fortification at this level should cost no more than about $5 per metric ton.

NEW DEVELOPMENTS IN WURLD WHEAT

A. I. Morgan, Chief, Engineering and Development Laboratory
Western Utilization Research and Development Division,
Agricultural Research Service, USDA, Albany, Calif.

The name WURLD wheat includes the initials of western utilization research. It is a new wheat food made by peeling wheat down to its aleurone layer. The result is a white, whole-kernel, convenient, nutritious food. The method consists of coating field wheat with strong caustic (lye) for a few minutes and then stripping off the weakened colored layers of bran by turbulent water washing, rinsing in water, bleaching in acetic acid solution, and finally drying the product.

By soaking and steam cooking the wheat before peeling with 30 percent caustic at 200°F., an amber-colored, crease-bran-free dry product is obtained which can be cooked by the consumer in

20 minutes. By merely warming the wheat instead of cooking, the result is a white product which can be cooked in 45 minutes. By abrasively milling a few percent of flour off this white kernel, the same product can be cooked in 20 minutes. The same cooking time results from cracking the cooked version of WURLD wheat. If cold wheat is peeled in 50 percent caustic at 120°F., the product retains most of its ability to make baked or extruded foods. Durum wheat, when cold peeled, can be extruded into pasta without being fully dried or milled.

WURLD wheat is especially well adapted to enrichment with soluble nutrients, such as lysine, methionine, or protein isolates. This is due to its wet processing, permeable condition, and whole kernel form.

In general, WURLD wheat shows a higher yield--up to 90 percent of food product--than conventional milling. The bran removed, however, is largely waste. About one-third consists of high fiber solids which can be pressed into a cake. Two-thirds are dissolved into the waste stream. This stream, by countercurrent water economy, can be kept to less than ten times the weight of wheat peeled. Four percent solid sodium hydroxide and one percent acetic acid are used, based on wheat.

Cost of processing uncooked WURLD wheat is estimated at 1 cent per pound, that of cooked WURLD wheat at 2 cents per pound. White and Club wheats yield more attractive and cheaper WURLD wheats than do red wheats, assuming the same raw wheat cost.

Consumer acceptance in Hong Kong and three locations in India was found to be good. Preliminary reports from Guam are likewise encouraging.

CEREAL BEVERAGES FOR THE MILLIONS

David A. Fellers, Research Chemist
Western Utilization Research and Development Division,
Agricultural Research Service, USDA, Albany, Calif.

Because of their universal appeal and wide use, cereals offer many advantages as starting materials for formulated food products designed to fill the needs of hungry nations. Economy, calories, and increased chances of acceptance are among these advantages. In combination with proper fortifying proteins, amino acids, vitamins, and minerals, the cereal product offers excellent nutritional value.

Of the possible product forms, beverages offer advantages of being familiar, classless, and simple in preparation and use. In preparing a beverage base from cereals, both starch and protein must be solubilized. Using wheat flour, we have worked out two simple and inexpensive processing schemes for making a beverage base.

In the first scheme, an acidified flour slurry (pH 1 to 3) is digested with pepsin. Subsequently, it is flash heated (215° to 250°F.) causing starch gelatinization and, because of the acid, partial hydrolysis. The slurry is then cooled, neutralized, and dried.

In the second scheme, a flour slurry is digested with a heat-stable bacterial alpha amylase at 160°F. The slurry is next cooled and acidified prior to addition of pepsin. Following proteolysis, it is filtered, neutralized, cooked, and dried. A small amount of stabilized vegetable oil added before drying improves the flavor fullness and body of the reconstituted beverage. Furthermore, in the dry state, stability to rancidity is improved and dusting is reduced.

The product of the amylase-pepsin process is highly dispersible even in cold water. The product of the pepsin-acid process is somewhat more difficult to reconstitute, probably because of the limited starch hydrolysis. A blend of four parts of wheat beverage base and one part of non-fat dry milk solids makes a palatable drink that is smooth, milklike in viscosity, generally bland, and nutritious.

MORE FOOD FROM WHEAT

Allan D. Shepherd, Head of Cereal Product and
Process Development Investigations, Western Utilization
Research and Development Division, Agricultural
Research Service, USDA, Albany, Calif.

The tremendous and increasing worldwide need for food, particularly protein, makes it imperative that heretofore untapped sources be investigated. One such source is the byproducts from flour milling. These byproducts are wholesome and contain highly nutritious components, but they lack acceptability for reasons of flavor, color, and high fiber content.

The simple remilling of these byproducts in a laboratory roller mill provides flours of much improved flavor, color, and fiber content. By adjusting the moisture content of the sample before remilling, we can exercise considerable control over the yield of flour and over the compositional factors, such as protein fiber, ash, vitamins, and amino acids. For example, by remilling the shorts fraction from a hard red spring wheat at the optimum moisture content of 9 to 10 percent, we obtain a flour of over

26 percent protein with a fiber content of 2.5 percent. The yield is 32 percent. The practicability of the process has been established by millers on production-scale equipment.

Protein quality of these flours as measured by protein efficiency ratio is substantially better than that of whole wheat. Amino acid analyses show a marked increase in the percentage of the limiting amino acid, lysine, which accounts for the improvement. B-vitamin and mineral analyses also show greatly enhanced levels over ordinary wheat flour. Our research shows that by the use of a simple remilling process on flour mill byproducts, it is possible to get more food from wheat.

ATTENDANCE
(Exclusive of WURDD Personnel)

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